



Formula overview

for determining total body water TBW, fat mass FM or fat free mass FFM for children and adolescents

Anthropometry:

- Lohmann (1986): $FM (kg) = wt \times (5.28/D) - 4.86$
- Deurenberg et al. (1990): $FM (\%) = ((562 - 4.2 (age (years) - 2))/D - (525 - 4.7 (age (years) - 2))),$
where D is body density:
Boys: $D (g/ml) = 1.690 - 0.0788 \times (\log (\text{sum of four skinfolds}))$
Girls: $D (g/ml) = 1.2063 - 0.0999 \times (\log (\text{sum of four skinfolds}))$
- Slaughter et al. (1988): **Total of SFD Subscapula + Triceps > 35mm:**
Boys: $BF (\%) = 0.783 \times (\text{SFD Subscapula} + \text{Triceps}) + 1.6$
Girls: $BF (\%) = 0.546 \times (\text{SFD Subscapula} + \text{Triceps}) + 9.7$
Total of SFD Subscapula + Triceps < 35mm:
Boys: $BF (\%) = 1.21 \times (\text{SFD Subscapula} + \text{Triceps}) - 0.008 \times (\text{SFD Subscapula} + \text{Triceps})^2 + k^*$
Girls: $BF (\%) = 1.33 \times (\text{SFD Subscapula} + \text{Triceps}) - 0.013 \times (\text{SFD Subscapula} + \text{Triceps})^2 - 2.5$

Bioelectrical Impedance Analysis:

- Cordain et al. (1988): $FFM = 6.86 + 0.81 \times (Ht^2/R)$ (Ht in cm)
- Davies et al. (1988): $TBW = -0.5 + 0.60 \times (Ht^2/R)$ (Ht in m)
- De Lorenzo et al. (1998): $FFM = 2.33 + 0.588 \times (Ht^2/R) + 0.211 \times wt$ (Ht in cm)
- Deurenberg et al. (1989): $FFM = 0.430 \times 104 \times Ht^2/R + 0.354 \times wt + 0.9 \times sex$ (sex: 1 = male, 2 = female; Ht in m)
- Deurenberg et al. (1990): **Boys and girls aged from 7 to 9 years:** $FFM = 0.640 \times 104 \times (Ht^2/R) + 4.83$
Girls of 10 - 12 and boys of 10 - 15 years: $FFM = 0.488 \times 104 \times (Ht^2/R) + 0.221 \times wt + 12.77 \times Ht - 14.7$
Girls older than 13 and boys older than 16 years:
 $FFM = 0.258 \times 104 \times (Ht^2/R) + 0.375 \times wt + 6,3 \times sex + 10.5 \times Ht - 0.164 \times age - 6.5$
(sex: 1 = male, 2 = female; Ht in m)
- Fjeld et al. (1990): $TBW = 0.76 + 0.18 \times (Ht^2/R) + 0.39 \times wt$ (Ht in cm)
- Houtkooper et al. (1989): $FM (\%) = -1.11 \times (Ht^2/R) + 1.04 \times wt + 15.16$ (Ht in cm)
- Houtkooper et al. (1992): $FFM = 0.61 \times (Ht^2/R) + 0.25 \times wt + 1.31$ (Ht in cm)
- Kushner et al. (1992): $TBW = 0.593 \times (Ht^2/R) + 0.065 \times wt + 0.04$ (Ht in cm)
- Schaefer et al. (1994): $FFM = 0.65 \times (Ht^2/R) + 0.68 \times age + 0.15$ (Ht in cm)
- Wabitsch et al. (1996): $TBW = 0.35 \times (Ht^2/R) + 0.27 \times age + 0.14 \times wt - 0.12$ (Ht in m)
- Wühl et al. (1996): $TBW = 1.99 + 0.144 \times (Ht^2/R) + 0.40 \times wt$ (Ht in cm)

Anthropometry combined with bioelectrical impedance analysis:

- Goran et al. (1996): $FFM (kg) = (0.16 \times (Ht^2/R)) + (0.67 \times wt) - (0.11 \times TSF (mm)) - (0.16 \times SSF (mm)) + (0.43 \times sex) + 2.41$ (sex: 1 = male, 2 = female; Ht in cm)

Definition:

wt = weight (kg); Ht = height (in m oder cm); TBW = Total Body Water in l; FFM = Fat-Free-Mass in kg; FM = Fat Mass or BF = Body Fat = Weight - FFM; TSF = Triceps Skinfold Thickness (mm); SSF = Subscapular skinfold thickness (mm); Age = years; SFD = Skinfold thickness; k* = Constant as per Tanner Maturation Stage